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Original Research Article

Sleep pattern and sleep disorders in school-going children aged 6-12 years and its association with screen time: a cross-sectional study from South Kerala during the COVID-19 pandemic

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ABSTRACT

Background: Poor sleep quality in school children can negatively impact their neurocognitive abilities and academic achievement. Increased screen time was shown to interfere with children's sleep habits and disrupts their sleep pattern. This study aimed to understand the sleep patterns and sleep disorders in school children and the influence of screen time on sleep in children during the COVID-19 pandemic.
Methods: This cross-sectional observational school-based study was done on 443 children aged 6-12 years. Data was collected through parent filled online questionnaire having a proforma and child sleep habit questionnaire (CSHQ), a validated questionnaire to assess sleep disorders in children
Results: Out of 443 children studied, the average sleep duration of the study population was 9:06 hours ±42:18 min and, 34.3% of the children slept less than 9 hours per day. The prevalence of sleep disorders was found to be 76.52%. Significant screen time after 8 PM was observed in 65.9% and 62.2 % of children had a total screen time of more than 2 hours. Increased screen time after 8 PM, delayed bedtime and wake-up time in children and also contributed to sleep disorders. Bedtime resistance and daytime sleepiness were more commonly observed in children with increased screen time.
Conclusions: Sleep disorders in children are more predominant than sleep deprivation. Increased screen time before bed was found to alter sleep patterns in children and increases bedtime resistance, daytime sleepiness, and sleep disorders.

Keywords: Screen time, Sleep disorders, COVID-19, CSHQ, Children

INTRODUCTION

Sleep is critical for maintaining attention and memory in school children, consequently influencing their academic performance. Wolfson and Carskadon observed that students with higher academic achievement went to bed sooner than their peers with lower academic performance.[1] Gruber et al found in a non-randomized controlled study that a school-based sleep education program intended to enhance sleep also improved academic performance in children.[2] A meta-analysis examining the relationship between sleep and academic performance in children revealed that sleep quantity, sleep quality, and daytime sleepiness affect academic performances in children.[3]

It was shown that sleep in children consistently decreased over the past 103 years.[4] The dark-light cycle is the most potent zeitgeber, which influences the pineal gland's melatonin production and thereby regulates the circadian rhythm of sleep. Increased exposure to artificial light and screens has decreased daily darkness, thereby interfering with melatonin synthesis, as well as shortening sleep duration.[5]

Children aged 6 to 10 had the maximum rise in overall screen use, according to a systematic analysis of 89 research conducted during the pandemic.[6] During the spread of COVID-19, social isolation and school closure curtailed outdoor physical activities and compelled children to adopt digital gadgets not just for recreation but also for academic activities, as the mode of instruction was online.[7]

Considering the soaring dependence on technology during the pandemic, it is vital to appreciate both the changes in children's screen time use and its impact on their sleep patterns in children. This study intends to measure digital gadget usage (screen time) among school-going children during the pandemic and its influence on sleep patterns and sleep disorders. Our primary objectives were (1) to determine the sleep pattern of school children and estimate the prevalence of sleep disorders (2) to estimate the parent-reported screen time among school-aged children (6-12 years) (3) to find an association between sleep patterns and disorders with screen time in children aged 6-12 years during pandemic.

METHODS

This cross-sectional analytical study was done on school children aged 6-12 years from randomly selected regular schools in South Kerala, India. Data were collected from August to November 2021. The required minimum sample size was calculated as 344. However, the epidemic necessitated the use of Google forms for data collection; as a result, we originally contacted 823 pupils and their parents, anticipating the difficulties in achieving a sufficient sample size. Google forms were distributed to the students with the help of their respective class teachers. All children from whom parental consent for the study was not obtained were excluded. The initial response rate was 56.6%, and 23 forms were rejected due to poor or erroneous data submission following the initial screening. Consequently, 443 students were included in our study. The questionnaire included a brief explanation of the purpose of the study, a Proforma designed to collect demographic information, and a few questions on screen time and screen usage patterns that might potentially impair sleep and CSHQ (child sleep habit questionnaire).

The CSHQ is a parent-completed questionnaire that has been used retrospectively to analyze children's sleep patterns and estimate the prevalence of sleep disorders. It consists of 33 scored questions and 7 extra items that are meant to give additional pertinent data about sleep habits. Parents are questioned about their children's sleep from a "typical" recent week. On a three-point scale, items are scored as "usually" if the sleep behavior occurred five to seven times per week, "sometimes" if it happened two to four times per week, and "rarely" if it happened zero to once per week. A few of the questionnaire's questions are scored in reverse so that higher scores consistently signal problematic habits. The CSHQ consists of items pertaining to key sleep domains that encompass the most prevalent clinical sleep disorders in children; hence, these questions are conceptually organized into eight subscales that mirror the domains: bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, sleep disordered breathing (SDB), and daytime sleepiness. A total sleep disturbances score is calculated as the sum of all CSHQ-scored questions and can range from 33 to 99 and a score of over 41 indicates a pediatric sleep disorder, as this cut-off has been shown to accurately identify 80% of children with clinically diagnosed sleep disorders.[8] CSHQ has also been validated in Indian children [9]

Statistical analysis

Data was analyzed using SPSS v 26. Qualitative variables were expressed as frequency and percentages and quantitative variables as mean and standard deviation. The association between screen time and sleep patterns in children was calculated using the chi-square test for categorical variables and the independent t test/ Mann-Whitney U test for quantitative variables. $P<0.05$ was considered statistically significant.

RESULTS

Out of 443 students enrolled in this study mean age of the group was 8.56±1.87 years. Males constituted 52.1% (n=231). The majority of the parents were college graduates or above with only 31.8% (n=141) of the fathers and 14.9% (n=66) of the mothers having an educational status below the high school level.

Sleep pattern

It was observed that mean sleep time of study population was 9:06 hours ±42:18 min and ranges from 7-11 hours. Mean bedtime was 9:56 PM±38:11 min and mean wake-up time was 6:57 AM±42:51 min. Out of 443 children, 34.3% of children slept for less than the ideal duration of 9 hours recommended for their age group (Figure 1).[10]

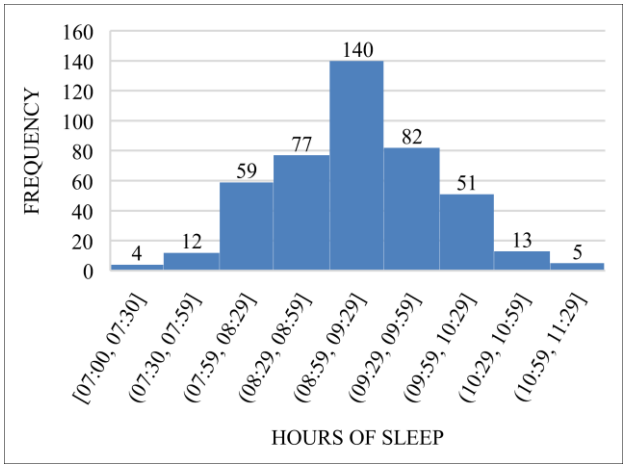

Figure 1: Distribution of total sleep time.

Sleep disorder

CSHQ total sleep disturbances scores ranged from 33 to 87 (M=47.00, SD=8.87), with 76.52% of the sample (n=339) meeting the diagnostic cut-off score of 41or above for a sleep disorder, and 23.48% (n=104) falling below this cut-off score. Hence Prevalence of sleep disorders in children aged 6-12 years according to this screening was found to be 76.52% [95% CI, 72.3-80.4%] (Figure 2). Younger age and lower educational qualification of the father were associated with a higher prevalence of sleep disorders in children (Table 2).

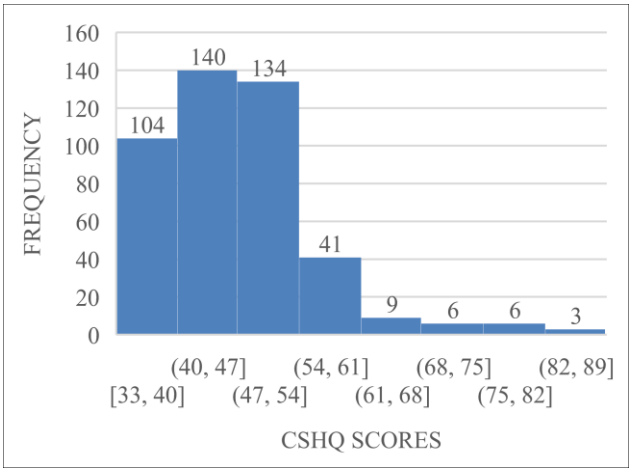

Figure 2: Distribution of CSHQ scores.

Screen time

Almost two third (65.9%) of the study participants had screen time for more than half an hour after 8 PM. Out of the total, 12.6% had internet access inside the bedroom and 62.2% of children had a total average screen time of more than 2 hours in a day (Table 1).

Higher educational qualifications and better job profiles of parents were associated with increased screen usage in children (Table 2).

Sleep duration and screen time

Bedtime and wake-up time were observed to be delayed in those children who had increased screen time after 8 PM ($p<0.001$) and in those with internet access inside the bedroom ($p<0.001$). Increased total screen time in a day was shown to have been associated with delayed bedtime. ($p<0.001$) (Table 1). Even though sleep duration was observed to be delayed in children with increased screen time, no significant relationship has been observed between these variables.

Sleep disorders and screen time

The proportion of children with CSHQ cut-off score of 41 or more (diagnostic of sleep disorders) was significantly high in children with increased screen time after 8 PM ($p=0.020$) (Table 1). While considering individual subscale scores, children with increased screen time after 8 PM were observed to have higher CSHQ scores in subscales such as daytime sleepiness ($p<0.001$), parasomnia ($p=0.03$), and bedtime resistance ($p=0.05$) compared to their peers with less screen time. Similarly, an increased total screen time of more than 4 hours in a day, increased individual subscale scores of daytime sleepiness ($p=0.01$). Access to the internet inside the bedroom significantly increased bedtime resistance ($p=0.04$) and sleep anxiety ($p=0.03$) in school children (Table 3).

Table 1: Screen time in children and its association with sleep pattern and sleep disorders.

Variables		Screen time	Sleep pattern			Sleep disorders (CSHQ scores)		
		Frequency (%)	**Bedtime (Mean) (PM)**	**Wake up time (Mean) (AM)**	**Total sleep time (Mean) (Hours)**	**CSHQ <41**	**CSHQ≥ 41**	**χ^2/ p**
Screen time after 8 PM (Hours)	<30 min	151 (34.1)	9:50	6:54	9:03	88	249	5.449/ 0.020
	30 min-<1	186 (42.0)	9:52	6:52	9:00			
	1-2	85 (19.2)	10:03	7:04	9:01	16	90	
	> 2	21 (4.7)	10:37	7:36	8:59			
P value			<0.001	<0.001	0.921			
Internet access inside bedroom	Yes	56 (12.6)	10:07	7:13	9:05	8	48	3.014/ 0.083
	No	387 (87.4)	9:52	6:53	9:00	96	291	
P value			<0.001	<0.001	0.069			
Total screen time (Hours)	< 2	167 (37.7)	9:50	6:53	9:02	88	279	4.621/ 0.202
	2-4	200 (45.1)	9:54	6:59	9:05			
	4-6	68 (15.3)	10:09	7:00	8:50	16	60	
	>6	8 (1.8)	10:33	7:16	8:43			
P value			<0.001	0.225	0.063			

Table 2: Association of demographic variables on screen time, sleep pattern and sleep disorders.

Demographic variables	Sleep disorders[¥] χ^2 /p value	Screen time[α] χ^2/ p value	Sleep deprivation[£] χ^2/ p value
Father's education	9.735/ 0.021	23.37/<0.001	--
Mother's education	--	16.87/<0.001	10.42/0.015
Father's occupation	--	12.23/ 0.007	--
Mother's occupation	--	11.46/ 0.003	6.775/0.034
Gender	--	--	--
Age (Years)	=0.005[#]	--	--

[#]Independent T test, ¥ grouped into 2 categories based on CSHQ scores <41 / ≥41, α grouped into 2 categories based on screen time, <4 hours / >4 hours, £ grouped into 2 categories based on sleep duration <9 hours/ > 9 hours

Table 3: Screen time and CSHQ subscale scores.

CSHQ subscales	Screen time after 8 PM, mean (SD)		Internet access inside the bedroom, mean (SD)		Total screen time per day, mean (SD)	
	<1 hour	>1 hour	No	Yes	<4 hour	>4 hour
	N=337	N=106	N=387	N=56	N=367	N=76
Bedtime resistance	11.5 (2.7)	12.1 (2.7) *	11.6 (2.7)	12.3 (2.8)*	11.8 (2.7)	11.3 (2.8)
Sleep duration	3.7 (1.2)	3.9 (1.3)	3.8 (1.2)	3.9 (1.3)	3.8 (1.2)	3.9 (1.3)
Sleep onset delay	1.4 (0.6)	1.5 (0.7)	1.4 (.6)	1.5 (.7)	1.4 (0.6)	1.4 (0.7)
Night wakings	3.7 (1.1)	3.8 (1.2)	3.8 (1.2)	3.7 (1.2)	3.8 (1.2)	3.7 (1.0)
Parasomnia	8.4 (2.4)	8.8 (2.3)*	8.4 (2.4)	8.8 (1.8)	8.5 (2.4)	8.5 (2.3)
Daytime sleepiness	11.7 (3.4)	13.2 (3.5) ***	12 (3.5)	12.5 (3.5)	11.9 (3.4)	13.1 (3.8)**
Sleep-disordered breathing	3.5 (1.2)	3.4 (1.1)	3.5 (1.2)	3.3 (0.6)	3.5 (1.2)	3.4 (1.1)
Sleep anxiety	7.2 (2.1)	7.4 (2.4)	7.1 (2.1)	7.8 (2.1)*	7.3 (2.1)	6.9 (2.4)

***p<0.001, **p<0.01, *p<0.05.

DISCUSSION

In our study, it was observed that children's average total sleep time was comparable to that reported in earlier studies conducted on Indian children without any significant change during the pandemic.[11,12] It was noted previously by Mindell et al that Indian children slept less than their western and other Asian counterparts.[13] In 2015, a study from India reported that 22.5% of urban children suffered from sleep deprivation.[14] Even though the average sleep duration of children in our study remained the same, the increased proportion of children with sleep deprivation (34.3%) that was observed can be attributed to sociocultural changes and technological advancement that occurred over the time period. A similar secular trend of consistent decrease in the duration of sleepin children over the years was also obvious in a systematic study on 690,747 children aged 5 to 18 years from 20 countries.[15]

According to earlier studies, the prevalence of sleep disorders in Indian children ranged from 42.7% to 59%.[12,15,16] It was evident from these earlier studies that the prevalence of the sleep disorders also has a rising trend in children over the years.[12,15,16] Reflecting a similar picture, almost two third of our study population was found to have a sleep disorder. Sleep problems are often overlooked by the parents and sleep hygiene practices such as bed routines and healthy presleep habits are rarely practiced.

Compared to the findings of Barathy et al from Puducherry, where only 32.6% of children reported spending more than two hours in front of a screen, it was observed that the proportion of our children using digital gadgets for more than 2 hours a day had doubled during the pandemic.[15] Higher educational qualifications and better jobs improve the socioeconomic status of the family and may invariably increase access to multiple digital gadgets at an earlier age. The usage of digital gadgets for purposes other than recreation has increased during the pandemic.[7] During the lockdown digital gadgets kept bonds between relatives through social media and helped the students to continue with their studies through virtual platforms and digital learning apps. Indian academy of pediatrics (IAP) recommends limiting screen time to a maximum of 2 hours, mainly by reducing recreational screen time. Shared media usage with parental monitoring to ensure the appropriateness of content was stressed in the guidelines.[17]

In our study, it was observed that screen usage at night and internet access in bedrooms was associated with a significant delay in bedtimes and wake-up times. A

similar finding was also observed in a study from China by Li et al involving 19,299 elementary school students, where electronic devices in the bedroom and multimedia use were found to be positively connected with later bedtimes, later wake-up times, and shorter sleep durations.[18] After evaluating 36 publications, Cain and Gradisar hypothesized that the use of technology could interfere with sleep (i) by shifting the sleep time; (ii) by causing physiological arousal, which disrupts sleep; and (iii) by altering melatonin secretion thereby delaying sleep onset.[19]

In our study children who had screen time after 8 PM had an increased prevalence of sleep disorders. Owens et al in a study found that increased daily television exposure and watching television at bedtime contributed to bedtime resistance, sleep onset delay, and sleep-related anxiety.[20] Whereas in our study increased screen time after 8 PM was associated with daytime sleepiness, parasomnia, and bedtime resistance, and access to the internet inside the bedroom significantly increased bedtime resistance and sleep anxiety in children. Similarly, an increased total screen time of more than 4 hours increased daytime sleepiness.

In school children, daytime sleepiness can impair their learning, thereby impeding academic performance.[21,22] Therefore it is essential to formulate 'digital rules' to encourage healthy screen usage in children. Regular bed routines have to be followed and to ensure that all screens are switched off 1 hour prior to bedtime. Adequate sleep with sleep hygiene is essential for the optimal functioning of the child and hence healthy regular sleep of adequate duration, appropriate timing, good quality, and without any disturbances has to be ensured in order to prevent sleep disorders in children.

Strength

The sufficient sample size and use of a validated questionnaire increased the accuracy of the findings thus enabling cross-cultural comparisons.

Limitations

All the data obtained were parent-reported, which may be vulnerable to subjective inaccuracies and recall biases. Due to our study's cross-sectional design, we could not determine temporal sequences, necessitating further prospective research using objective sleep analysis.

CONCLUSION

The present study found that sleep disorders in school children are almost double the observed sleep deprivation. Nearly 2/3rd of the children had considerable screen time before bedtime. Increased screen time at night in school children is positively linked with delayed bedtime and wake-up time. Increased screen time mostly before bedtime significantly increased sleep disorders in children than total screen usage in a day. Increased screen usage prior to bed increased daytime sleepiness, parasomnia, and bedtime resistance.

Sleep quality in school children is essential for their learning and academic excellence. Considering the high burden, routine screening for sleep disorders has to be done for all children attending pediatric outpatient clinics. Regular nocturnal sleep patterns must be promoted by parents by implementing consistent meal times and bedtime routines and limiting screen time during the night. An effort to limit total screen time to 2 hours/day by limiting maximum recreational screen activities has to be made. Future research should investigate the effects of poor sleep in children in detail and study the efficacy of public health initiatives if implemented to promote sleep and their impact on health and well-being.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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